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# AN EXPERIMENTAL STUDY OF IMAGINATION<sup>1</sup>

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## INTRODUCTION

The word Imagination and its cognate forms are familiar both in everyday speech and in the technical language of psychology. In neither context, however, have they the established position enjoyed by the correlative term Memory. Under these circumstances, it seemed worth while to enquire into the psychological status of Imagination, to attempt an experimental control of certain of the experiences thus denominated, and by these means to work towards a definition and delimitation of the concept. The present study is no more than a first beginning, but we hope that its results are sufficient to justify the recourse to the experimental method.

Alongside of the experimental work, which will be described later, we undertook three preliminary enquiries: a somewhat

<sup>1</sup>From the Psychological Laboratory of Cornell University.

casual investigation of the meanings attached to the word Imagination by ordinary educated persons; a canvass of literary usage; and an analysis of the treatment of Imagination in current psychological text-books and monographs.

(1) *Ordinary Usage.* The verb 'to imagine' is used with many shades of meaning. We found, however, two fairly characteristic conversational uses: 'to imagine' is either to set an imaginary something before the mind's eye, or it is, more generally, to make an hypothesis, to suppose something of an unusual or difficult kind. Instances of a simple sort would be: 'Now you are to imagine a very long lane,' and 'Could you imagine anything worse?' The turn of mind which is commonly called imaginative is suggested by various proverbial expressions: counting chickens before they are hatched, crossing bridges before you come to them, building castles in Spain, etc. The imaginative person is also credited with a certain lightness or instability of temperament, though perhaps the only feature common to all mental constitutions classed popularly as imaginative is the negative one of a lack of thorough-going stupidity. Sometimes, as we have indicated for the verb, 'imaginative' has a visual reference; as a rule, however, this reference appears to be no more obvious to the speaker than it is in the case of the substantives 'insight' and 'foresight.'

(2) *Literary Usage.* One of the commonest uses of the word 'imagination,' in literature as in ordinary conversation (where, however, if our notes are to be trusted, it is far less common than the adjective and the verb), is to denote a tendency to distort facts, to embroider, to romance: cf. the phrase 'lively imagination.' Akin to this tendency is the ability to live in a subjectively colored world unlike the gray world of reality, a temperamental optimism or pessimism. With a very slightly different shade of meaning, imagination becomes the ability to see everything in a rosy light; or, again, the faculty of seeing things in the very high color that strong feeling paints. In some cases, the power of sympathy, of feeling with and for, is actually called imagination. Rich endowment on the creative as well as on the affective side of human nature produces the reformer, the prophet, the revolutionist, the visionary. Emphasis is often laid on this creative factor, the power of invention; imagination implies fluidity of associations, quickness of wit, the faculty of forming new combinations, the ability to see likeness (the one in the many) and to draw distinction (to see the many in the one). Finally, we note that the imaginative person is, with approximately equal frequency, described as the player, the dreamer *par excellence*, the purposeless idler, and as the possessor of an unusually high degree of concentration and voluntary control.<sup>1</sup>

(3) *Psychological Usage.* It is easy to overestimate the significance of a formal definition. At the same time, the framing of a definition marks a stage in the development of our knowledge of a subject,

<sup>1</sup> This paragraph is a condensed summary of the results gathered from a fairly wide study of poets, essayists, divines, and articles dealing specially with the Imagination. Of the latter we may mention, by way of illustration: H. Maxwell, *Imagination*, Blackwood's Edinburgh Magazine, cl, 1891, 576; R. C. Witt, *The Imaginative Faculty*, Westminster Review, clii, 1900, 217; What is a Strong Imagination? *The Spectator*, lxii, 1889, 506; *The Imagination and its Development*, *ibid.*, lxi, 1890, 372; *The Conservation of the Imagination*, *The Saturday Review*, lxxxviii, 1900, 576; *The Imagination*, from Lectures by J. R. Lowell, *The Century Magazine*, xlvii (N. S. xxv), 1893-4, 716; J. Sully, *Studies of Childhood*: i. *The Age of Imagination*, *Popular Science Monthly*, xlv, 1894, 323. The greater part of the authors consulted wrote in English; but sporadic search among French and German writers did not reveal any striking differences in their use of the term.

while the definition itself has at least the value of a classificatory rubric. When James Mill writes that "an imagination is the name of a *train*; . . . nor is there any train of ideas, to which the term imagination may not be applied,"<sup>1</sup> we have our bearings within a self-consistent and comprehensive psychological system. It seems fair to argue, then, that the casualness and vagueness of the definitions of Imagination offered in current text-books and monographs imply a real uncertainty as to its psychological status. Imagination is "the representative function of mind,"<sup>2</sup> or "the faculty of reproducing copies of originals once felt"<sup>3</sup>; to imagine is "merely to think of an object,"<sup>4</sup> or "to construct with images."<sup>5</sup> More specifically, the creative imagination "consists in the property images have of gathering into new combinations through the effect of a spontaneity"<sup>6</sup>; "it is the power of developing an object by being absorbed in it; it is the power of self-development of an object when we live it or live in it."<sup>7</sup> Or it may be both of these things at once: imagination "is the art, spontaneous or reflective, of forming syntheses or mental combinations," while it is also "the power of giving or attributing existence to the representations, of transforming them into beliefs or actions, in a word, of objectifying them."<sup>8</sup> These and similar statements are plainly partial or tentative; they have their useful place in the discussions in which they occur; but they certainly do not possess any general validity. The clearest and most positive definitions that we have found are the following three. "Imagination in the wider sense," says Höffding, "is identical with the power of ideation; . . . in the narrower sense Imagination is the power of forming concrete ideas."<sup>9</sup> Here is the modern form of the representative faculty. Wundt modifies the definition, to make imagination a "form of apperceptive activity;" imagination is "a thinking in particular sense ideas," a "perceptual form of intellectual elaboration."<sup>10</sup> Finally, Baldwin introduces the affective factor; "imagination is the affective or felt apprehension of relations among images."<sup>11</sup>

Is there, then, any constitutive *differentia* of the imaginative consciousness, any marked character in which its contents differ from the contents of other typical consciousnesses? Most psychologists are silent upon this point. Külpe notes the "oscillation and migration, the shrinking and expanding, of the subjective images, when they are the result . . . of the free and fortuitous play of imagination;"<sup>12</sup> and Wundt emphasizes the "sensory vividness and picturableness of its ideas."<sup>13</sup> It would, however, be unsafe to generalize upon either basis.

Other principles of distinction have, indeed, been proposed. Thus

<sup>1</sup> Analysis of the Phenomena of the Human Mind, i, 1869, 239.

<sup>2</sup> J. M. Baldwin: Handbook of Psychology; Senses and Intellect, 1890, 213.

<sup>3</sup> W. James: Principles of Psychology, ii, 1890, 44.

<sup>4</sup> G. F. Stout: Analytic Psychology, ii, 1909, 260.

<sup>5</sup> L. Arréat: Mémoire et imagination, 1895, 156.

<sup>6</sup> T. Ribot: Essay on the Creative Imagination, tr. 1906, 330.

<sup>7</sup> W. Mitchell: Structure and Growth of the Mind, 1907, 353.

<sup>8</sup> L. Dugas: L'imagination, 1903, 3, 308.

<sup>9</sup> H. Höffding: Outlines of Psychology, 178; Psychologie in Umrissen, 1887, 223 f.: "das Vermögen zur Neubildung konkreter Vorstellungen."

<sup>10</sup> W. Wundt: Outlines of Psychology, tr. 1897, 262; tr. 1907, 298; Human and Animal Psychology, tr. 1896, 316; Physiologische Psychologie, iii, 1903, 577, 632; Mythos und Religion, i, 1905, 5 ff., 62 f.

<sup>11</sup> *Op. cit.*, 242.

<sup>12</sup> O. Külpe: Outlines of Psychology, tr. 1909, 185; Ueber die Objectivierung und Subjectivierung von Sinneseindrücken, Philosophische Studien, xix, 1902, 508 ff. Münsterberg speaks similarly of the *Unbeständigkeit der Vorstellung*, and of the *bunte Wechsel der Phantasiegestalten*, Grundzüge der Psychologie, i, 1900, 341. Cf. F. Paulhan, Psychologie de l'invention, 1901, 7.

<sup>13</sup> Physiologische Psychologie, iii, 1903, 632, 634.

Wundt writes that the distinguishing mark of imagination is "the mode of connection of ideas;" "in all cases connection takes place according to a definite plan."<sup>1</sup> We have "an essential mark of the apperceptive process in the positive characteristic . . . that it depends on a voluntary synthesis."<sup>2</sup> Jodl speaks, in the same sense, of a "voluntarily effected reproduction."<sup>3</sup> Külpe enters on more familiar ground in the statement that "imagination is characterized . . . by the realization that the given ideas present something new."<sup>4</sup> We find many passages to this effect: "the creative imagination requires something *new*—this is its peculiar and essential mark;"<sup>5</sup> "its two essential characteristics are originality and power;"<sup>6</sup> "the component ideas . . . are brought into new combinations;"<sup>7</sup> and so on. Bain thinks that the "grand peculiarity" of imagination, as distinct from thought, is "the presence of an *emotional* element in the combinations;"<sup>8</sup> a point of view which, as we have seen, is also represented by Baldwin. Ribot declares that "the imagination is subjective, personal, anthropocentric; . . . the understanding . . . is objective, impersonal, receives from outside."<sup>9</sup> This last is evidently a logical distinction, and tells us nothing of the mental processes involved. And the other peculiarities noted, voluntary synthesis, novelty of combination, and the presence of an emotion, are after all marks of difference within the intellectual processes themselves, and cannot be considered as ultimate. If the presence of images might distinguish imagination from rational thought, as a voluntary synthesis distinguishes it from memory, Wundt would clearly make his point; but it is unquestionable that rational thought may itself proceed in terms of images.

Failing to obtain a satisfactory definition or *differentia* of Imagination, we may turn to the statistical method, and enquire how, in general, it is treated in the standard psychologies; what part-processes are said to make it up; under what general headings, or in what general context, it is placed. It is somewhat surprising that current psychologies rarely give a separate chapter to Imagination; in many of them, it does not even share a chapter heading; occasionally, the term does not appear in the index; not infrequently, its importance in the context is indicated merely by the use of a capital letter.<sup>10</sup> It is also, perhaps, somewhat surprising to find that its discussion may appear, almost as if by chance, under the rubrics Image or Representation, Thought, Feeling, and Will.<sup>11</sup>

As a type of *intellectual* consciousness, Imagination is usually treated under the general heading of Ideation, or more definitely under Representation, Reproduction, or Centrally Excited Sensation; occasionally under Association or Thought-connection.<sup>12</sup> It is almost always in close proximity to Memory. Emphasis is laid rather on its complexity of contents than on its uniqueness as an intellectual formation; we read, as in any discussion of the intellectual processes at large, of the part played by affective, volitional, and motor or kinæsthetic factors. A few instances must suffice. Ladd and Ribot stress the motor aspect:

<sup>1</sup> Physiologische Psychologie, iii, 1903, 631.

<sup>2</sup> Outlines of Psychology, tr. 1897, 261; tr. 1907, 299.

<sup>3</sup> Lehrbuch der Psychologie, 1896, 509; ii, 1903, 161 f.

<sup>4</sup> Outlines of Psychology, tr. 1909, 188.

<sup>5</sup> T. Ribot: Creative Imagination, tr. 1906, 5, 11.

<sup>6</sup> L. Dugas: L'imagination, 3.

<sup>7</sup> T. Ziehen: Introd. to Physiological Psychology, tr. 1895, 168. Cf. Mitchell, *op. cit.*, 350 f.; A. Bain: Senses and Intellect, 1868, 570.

<sup>8</sup> *Op. cit.*, 599.

<sup>9</sup> *Op. cit.*, 10.

<sup>10</sup> Nine such cases were actually counted.

<sup>11</sup> Actual count from 20 works, chosen at random from our list of authorities, gave the ratio 16:16:15:12.

<sup>12</sup> So T. Lipps: Grundtatsachen des Seelenlebens, 1883, ch. xx.

"especially must we insist upon the prominence of motor consciousness in the neural conditions of productive imagination;"<sup>1</sup> "my aim is to extend [the motor] formula, and to show that it explains, in large measure at least, the origin of the creative imagination."<sup>2</sup> Bain and the French authors insist on the emotional aspect; there is an "emotional condition of originality of mind in any department;"<sup>3</sup> we must recognize the existence, "beyond images, of another factor, instinctive or emotional in form."<sup>4</sup> Baldwin's paragraphs recur constantly to preference, intention, volition, regulation of will;<sup>5</sup> Ribot finds in voluntary activity the closest analogy to the creative imagination;<sup>6</sup> Jodl remarks that the conduct of association by the attention passes over, almost indistinguishably, into the activity of imagination.<sup>7</sup>

Imagination, it is generally agreed, must in some way be concerned with images. But opinion differs as to what constitutes an image; some writers appear to include in that category even the vaguest of abstractions. "These ideas of the imagination may be generalized," says Ziehen.<sup>8</sup> "When used as a sign, the image may be made so schematic as to contain nothing irrelevant; and the abstraction may be so great that the sign loses the character of a sample, and becomes an arbitrary sign like a word."<sup>9</sup> "The image, deprived little by little of its own characteristics, is nothing more than a shadow."<sup>10</sup> The point is even made that "imagination exercises itself as well in the domain of pure ideas or abstractions as in that of concrete realities."<sup>11</sup> It is plainly impossible to generalize Wundt's criterion of sensory vividness. Despite the terminology of imagery, the trend of opinion seems to be not only that "between the creative imagination and rational investigation there is a community of nature,"<sup>12</sup> but also that the line of separation between thought and imagination is shifting and uncertain.<sup>13</sup>

There is a marked difference between the treatment of imagination as an intellectual, and its treatment as an affective or volitional consciousness. Nearly as many writers offer the latter as offer the former treatment; but they do not offer it as a matter of course; they are plainly on the defensive. Hence they urge, with great insistence, that "the *emotional* factor yields in importance to no other;"<sup>14</sup> that "it is a character of imaginative creation . . . almost essential that it be preceded, prepared for and accompanied by affective phenomena;"<sup>15</sup> that "imaginative" are identical with "emotion-ruled combinations;"<sup>16</sup>

<sup>1</sup> G. T. Ladd: *Psychology Descriptive and Explanatory*, 1894, 410.

<sup>2</sup> T. Ribot: *Creative Imagination*, 3, 99, 113, 248, 318 ff.

<sup>3</sup> A. Bain: *Senses and Intellect*, 593, 599 ff.; *Mental and Moral Science*, 586; note to James Mill's *Analysis*, i, 245 f.

<sup>4</sup> Ribot: *op. cit.*, 7 f., 12, 31, ff., 79 ff.; L. Arréat, *Mémoire et imagination*, 122, 167 f.; L. Dugas: *L'imagination*, 3 ff., 7; F. Paulhan: *Psychologie de l'invention*, 28, 43.

<sup>5</sup> *Senses and Intellect*, 223 ff.

<sup>6</sup> *Creative Imagination*, 9 ff.

<sup>7</sup> *Lehrbuch der Psychologie*, 1896, 508; ii, 1903, 161 f., 166. Cf. G. Spiller: *The Mind of Man*, 1902, 496 ff. (imagination as attention-determined); Ribot: *Creative Imagination*, 86 (identity of attention and imaginative synthesis); Dugas: *op. cit.*, 100; Paulhan: *op. cit.*, 67. Stout (*Analytic Psychology*, ii, ch. xi) treats of imagination together with belief.

<sup>8</sup> *Introd. to Physiological Psychology*, tr. 1895, 168.

<sup>9</sup> W. Mitchell: *op. cit.*, 364; cf. 371 and 185 f.

<sup>10</sup> Ribot: *op. cit.*, 18.

<sup>11</sup> Dugas: *op. cit.*, i. As a rule, however, the authors halt on the hither side of this statement: cf. Dugas: 3 f. 105, 198, 334; Ribot: *op. cit.*, 18, 184 f., 193, 207 ff., 236, 251 ff. 92 f.; Arréat: *op. cit.*, ch. vi (cf. pp. 11, 103); Ladd: *op. cit.*, 415; Mitchell: passages, cited above; Lipps: *op. cit.*, 469.

<sup>12</sup> Ribot: *op. cit.*, 29.

<sup>13</sup> Cf. Ladd's discussion: *op. cit.*, 431 f.

<sup>14</sup> Ribot: *op. cit.*, 31.

<sup>15</sup> Paulhan: *op. cit.*, 28.

<sup>16</sup> Bain: *op. cit.*, 602.

that "thought is the representative or cognitive apprehension of relations among notions; imagination is the affective or felt apprehension of relations among images,"<sup>1</sup> And emphasis on the *volitional* aspect, if again somewhat less frequent, is at least as insistent. "Memory images change under the influence of our feelings and volition to images of imagination:"<sup>2</sup> "the active imagination involves the exercise of will in some of its forms, whether it be the positive attempt to control the images of fancy or the merest supervision and direction of their play;"<sup>3</sup> not only is "imagination in the intellectual order the equivalent of will in the realm of movements,"<sup>4</sup> but the two are identical so far as the part (an important part) played by movements is concerned;<sup>5</sup> "intellectual creation is altogether analogous to voluntary activity;"<sup>6</sup> "the image is, under an elementary form, a complete volition."<sup>7</sup> —

It must be understood that the summary here given is inadequate, not only to the subject of the psychology of imagination, but also to our own survey of that subject. We have made no mention, *e. g.*, of such matters as the distinction between passive and active imagination; and we have refrained from multiplying quotations. At the same time, we hope that the impression left upon the reader by the above paragraphs is essentially correct.

Our preliminary study has left us with mainly negative results. We have found the term Imagination used very variously both in ordinary speech and in the psychologies, we have found scarce and inadequate definitions, no distinctive mark or marks of a reliable kind, and a pretty even distribution of emphasis among the four psychological rubrics of Idea, Thought, Feeling and Will. The very character of these rubrics, which are an inheritance from the faculty psychology, shows that no really analytical work has been attempted; psychologists have relied, for an account of imagination, upon their own self-observation and reflection, upon tradition, upon the requirements of a system. This is not to say that their accounts are wrong; on the contrary, they probably contain a good proportion of truth; but it means that there is no way of separating fact from fiction; we must accept an image-theory, or an affective theory, or a motor theory, or a volitional theory, in large measure by faith, or we must try to keep in the safe path by eclecticism and compromise.<sup>8</sup>

These are precisely the circumstances under which, if we may judge by historical analogy, assistance may be expected

<sup>1</sup> Baldwin: *op. cit.*, 242.

<sup>2</sup> Wundt: *Outlines of Psychology*, tr. 1897, 261; tr. 1907, 299.

<sup>3</sup> Baldwin: *op. cit.*, 226.

<sup>4</sup> Ribot: *op. cit.*, 9.

<sup>5</sup> *Ibid.*, 11.

<sup>6</sup> Paulhan: *op. cit.*, 6.

<sup>7</sup> Dugas: *op. cit.*, 100.

<sup>8</sup> No one, for instance, can read without psychological profit such a work as E. Lucka's *Die Phantasie, eine psychologische Untersuchung* (1908); but no one, we suppose, will doubt that the writer's analyses and classifications are provisional and temperamental, rather than objective and final.

from the experimental method. But experiment must begin with the relatively simple, and not with the complex. The following sections are offered as a contribution towards that *Elementaranalyse der Phantasie*, which Wundt has prescribed as the foundation of a psychology of Imagination.<sup>1</sup>

## § I. A COMPARISON OF PERCEPTION WITH THE IMAGE OF IMAGINATION

The object of our first experiments was to build up a perceptual consciousness under conditions which should seem to the observer to be those of the formation of an imaginative consciousness. A visual stimulus was presented, gradually and with increasing definiteness, while the observer was asked to imagine the object whose color and form were thus given in perception. Hence by 'image of imagination' we here mean, not the elementary image-process that is co-ordinate with sensation, but such an image arises in a mind of the visual type at the command, *e. g.*, 'Shut your eyes and think of an orange.'

The Cornell Laboratory possesses a dark room, 5 x 6.5 m., which is set longwise to the middle of a light, gray-tinted room of considerably larger size. The dividing wall contains, at its centre, a window of 1 x 1.5 m., which is filled with a sheet of ground glass, and which may be closed on the light-room side by two swinging shutters that can be made to stand at any angle. For the purposes of the present experiment, a black cardboard screen, with a central opening of 36 x 36 cm., was placed in the dark room immediately behind the ground glass. Facing the glass, in the dark room, was a projection lantern, whose arc-lamp was replaced as occasion required by various types and powers of incandescent lamp. The light room is profusely supplied with incandescent lamps; and after some preliminary trials with daylight, we decided to use this artificial light throughout the experiments.

Our first problem was to determine the color-limen for the various stimuli that we intended to employ, and we succeeded in making this determination for a certain red, orange, deep yellow, light yellow, green and blue. The observer sat, in the light room, at a distance of about 8 m. from the ground-glass window. It was the task of the experimenter to vary the luminosity of the lamp in the lantern, the screens of ground and colored glass, colored and colorless gelatine, and white tissue paper, necessary to reduce the light from the lantern, the distance of the lantern from the window and from these various media, and (on the other side of the ground-

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<sup>1</sup> *Mythus und Religion*, i, 1905, 17 ff.

glass window) the illumination of the observation room, in such a way that the open square should appear just noticeably colored, without there being any such glow or shine upon the glass as could suggest the presence of a source of light behind it. After a great deal of empirical testing, this end was attained, with a satisfactoriness and a precision that we ourselves—discouraged by repeated failures—had at last not dared to expect. Serial determinations of the limen of hue were obtained from Professor Titchener and the writer; a number of less systematic observations were made by Professor Bentley. The apparatus, we may repeat, was clumsy and empirical; but it worked (apart from errors of manipulation, to which we later refer) with admirable sureness and delicacy. We were especially on the watch for changes of tint; but we were able to eliminate them, positively for ourselves, and at least so far that they escaped notice for all of our observers.

The limen was thus determined as a diffused flush of color over the open square. The next step was to shape this flush into the representation of some object of perception. We prepared a set of black cloth-covered screens, in which were cut the forms of certain familiar objects; the forms were thus represented by holes in the screens. The edges of the forms were softened in outline by layers of fine black gauze, which projected successively farther and farther into the holes. The screens themselves were hung upon a rigid cross-line, along which they could be silently shifted in or out of their place behind the open square. A solid screen was used, to fill the square, while the stimulus-screens were in motion. When this solid screen was removed, the colored light shone through the reducing and diffusing media and the stimulus-screen, and the faintly colored and hazily outlined form lay upon or rather within the background of neutral gray.

The stimuli were presented in a definite order: a tomato (red), a book (blue), a banana (deep yellow), an orange (orange), a leaf (green), a lemon (light yellow). The adoption of a fixed procedure was necessary, since the apparatus required the services of three experimenters, and confusion might easily arise. One experimenter had charge of the lantern-lights, colored and ground glasses, colored and colorless gelatines, and tissues. A second ran the stimulus-screens into place, gave them a very slight, slow motion during their exposure (in imitation of the oscillations of a 'subjective' image), and replaced them on signal by the solid screen. A third sat in the light room, with the observer, to give instructions, take down introspective reports, and signal to the experimenters in the dark room for the appearance or removal of a particular stimulus. The electrical signal-

apparatus was arranged on the floor, under the desk at which this third experimenter sat; as the wires were concealed, and the experimenter's hands were free, the connection with the dark room was, unless mistakes of manipulation occurred, not suspected by any observer.

The experimenter who was in charge of the lantern had an exact table of the changes required to raise the color-stimulus from a definitely subliminal to a moderately supraliminal value. This table was based upon the serial results obtained from the observers mentioned above. When the signal for a particular stimulus was given, the color-stimulus was exposed, step by step, as the table prescribed, and in a tempo that had been standardized by practice. That the observer, in reporting an image, really perceived the stimulus, at any rate in the great majority of cases, seems to us to be proved by the fact that in only one single instance, throughout the entire series of successful experiments, did an observer report an image before the stimulus was (1) supraliminal for the co-operating experimenter and (2) of such objective intensity that its perceptibility might be expected from the results of the preliminary control experiments. It may, of course, be objected that this proof is not demonstrative: the experimenter may have been suggestible, and the position of the limen may vary considerably from observer to observer. At the end of the enquiry we accordingly took control observations from several of our graduate observers; and we found (3) that, when the arrangement of the experiment was explained to them, so that they were in the position of the co-operating experimenter in the actual experiments, they invariably recognized the appearance of the stimulus at or before the point at which they had previously reported an image of imagination.

Care was needed that no sound should come from the dark room; that the forms should oscillate or flicker into view very gradually; and that no shimmer of light should show between the edges of the screens as the stimuli passed in and out. The first of the sources of error was easily avoided; mistakes in manipulation occasionally occurred, however, and were, naturally, fatal to the success of the experiment with the observer in question. They will be noted in detail in what follows. We discovered no other source of error in the experiments.

A white fixation-mark was placed on the ground glass window at the centre of the open square. The work was done, as we have intimated, in the evening and by artificial light; all preparations were carefully made beforehand, so that the observer supposed that he and the (third) experimenter were the only persons present in the laboratory at the time of ob-

servation. Instruction was made as simple as possible; the observer was merely told to fixate the white point, and to hold this fixation while he 'imagined' a colored object,—“for instance, a tomato.” He was then to describe his 'image,' if any image took shape. As soon as the description was begun, the attention of the observer was distracted from the window by some indifferent question ('What was that, once more'? or 'Quite clear, did you say'? or something of the kind), and at the same moment the experimenter signalled to the dark room for the turning out of the lantern-lamp or the swinging into place of the solid black screen.

No blank experiments were introduced, as we feared that their introduction would reveal the actually perceptual character of the induced 'image.'

*Experiment I.* Partly in order to rehearse the technique of the experiment, partly in order to see what would happen with wholly unsophisticated observers, our first observations were taken from three children; two girls of 13 and 14, and a boy of 10. The elder girl took the perceptions, as a matter of course, for images of imagination. The younger girl was excited and pleased by the 'images,' but had no suspicion of their perceptual character; she was astonished and chagrined when informed, the next day, of the arrangement and object of the experiment. The boy caught a flash of light (due to faulty manipulation in the dark room) early in the course of the experiment, and jumped to the conclusion that he was seeing 'shadows' cast somehow upon the screen.

*Experiment II.* Full sets of observations were obtained from a group of 27 observers, of whom 19 were sophomores in the university, and 8 were graduate students engaged in advanced work in the laboratory. Only 3 of these 8, however, were familiar with their furniture of images, and had worked experimentally on the topic of imagery.

Three of the undergraduate observers were ruled out, early in the experiment, by an error of technique, which was at once pounced upon and reported. The remaining 24, men and women alike, invariably mistook the perceptual for the imaginative consciousness. At the end of the series, after all the introspections had been recorded, the observer was asked whether he was 'quite sure that he had imagined all these things.' The question almost always aroused surprise, and at times indignation. Yet when asked, further, if he had ever had such images before, he would usually reply that 'he could not remember that he had; but then, he had never tried.'

It is unnecessary to quote the introspections in detail. The following remarks are taken each from the report of a different observer.

"It seems strange; because you see so many colors, and know that they are in your mind; and yet they look like shadows." "I can spread it [the color] over if I want to." "It is a pure memory, with a little effort I could move it to the wall." "It is just like seeing things in the dark; I had it in my mind." "It is just as imagination makes it." "I can get blue better, because I have been working with a blue square lately." "I can get it steadily so long as I keep my mind absolutely on it." "I can get the shading on it as I think of it; at first I think it flat, as if painted." "I can see the veining of the leaf and all." "The banana is up on end; I must have been thinking of it growing." "It is more distinct than I usually do [than the images I usually have]; but I have never tried much." "I got it; that was grand." "I am imagining it all; it's all imagination." "Feels as if I was making them up in my mind." "I get thinking of it, and it turns up."

Several times an observer remarked, towards the end of the series, that his images were something like after-images, and that he felt he could move them by moving his eyes; here, no doubt, the slight oscillation and fluctuation of the stimulus were in play. One graduate observer apologized for her 'poor imagination,' and said she could get forms but not colors; as a matter of fact, she failed to see the color of the stimulus even when it was increased very considerably beyond the ordinary supraliminal point; the forms she regarded as imaginative. Another graduate observer, who had had long experience in the laboratory and had worked to some extent with imagery, showed, both by the time of appearance of the image and by its characteristics (shape, position, size), that he was incorporating the perception in it, while he nevertheless supplied a context of pure imagery: the tomato was seen painted on a can, the book was a particular book whose title could be read, the lemon was lying on a table, the leaf was a pressed leaf with red markings on it. All the observers noted that the banana was on end, and not as they had been supposing they thought of it; yet the circumstance aroused no suspicion. Some saw an elm leaf when they had been trying for a maple leaf. The observers not infrequently volunteered the statement that they could continue to hold the image after closing the eyes.

There is, then, no ambiguity about the results. The experiment is, however, open to the objection that the observations were made, for the most part, by unpractised observers.

*Experiment III.* To meet this objection, we repeated the experiment, after a year's interval, with five graduate students: *K*, *S*, *T* (men), and *C* and *V* (women). All had had practice, and *T* and *V* unusually extended practice, in the observation of images.

*S* was for some time confused: at first he thought the

figures imaginary; then he speculated whether they might not be after-images of some sort, or akin to after-images. Finally, after the appearance of the fourth form, he remarked: "It seems like a perception, though the attention is more active than in perception; yet I feel sure that it is there, and that I did not make it; it is more permanent and distinct than an image." The permanence and distinctness were, unluckily, due to faulty technique; the signal to put out the light failed to carry its message, and the stimulus was left showing at rest.

*T* thought that the 'image' was rather more like an after-image than the images he was accustomed to get in daylight; but he was emphatic that it was not a perception. *K*, too, insisted that the figures were imaginative.

*C* took the perception for an image of imagination until a mistake of technique (with the fourth form) revealed its real nature. *V* added many imaginary details, such as 'printing' on the book, but was sure that the figures were "all imagination, of course"; "quite like those I get in the daytime—perhaps more normal"; "more strain than in a perception" (*cf. S's* active attention); "could feel it formed in my mind—came right out of me"; "if I hadn't known I was imagining, should have thought it real."

The results thus confirm those of the previous experiments. And the net outcome of the work is, we think, positive and important enough to justify the time and labor spent upon its preliminaries. We find, in brief, that a visual perception of distinctly supraliminal value may, and under our conditions does, pass—even with specially trained observers—for an image of imagination. We are at a disadvantage in not being able to express our stimuli in quantitative terms. This much may, however, be said: at the conclusion of the experiments, a demonstration of the colored forms was made to a number of students in the psychological department, and to some psychologically competent visitors. Every one of these observers showed great surprise; most of them 'would, of course, take our word' for the facts, but could hardly credit them; a few remained entirely incredulous—"we asked them to believe too much." These attitudes are sufficient warrant for the normally supraliminal character of the stimuli employed.

*Historical Note.* Münsterberg concludes from his experiments on the mis-reading of words "dass die im normalen Zustand reproduzierten Empfindungen unter günstigen Bedingungen von sinnlichen Eindrücken nicht unterschieden werden können" (Beiträge zur experimentellen Psychologie, iv, 1892, 22). Külpe remarks that "the limits of possible variation in these experiments are plainly restricted; and the experiments themselves cannot be considered as wholly free from objection . . . The observer's statement that he clearly saw the whole

word is hardly a guarantee that errors [of the kinds specified in the criticism] were eliminated" (Outlines of Psychology, tr. 1909, 183). Pillsbury's results, gained from similar experiments, "seem to show that the centrally excited sensation, no matter how certain of its existence we may be, possesses certain characteristic differences that distinguish it from the peripherally excited." "Letters wrongly completed were said, *e. g.*, to be of a different color from those which were actually present upon the screen; were less definite in outline; and were less stable, *i. e.*, seemed to be in motion over the word." Pillsbury adds that the method is not suited to the problem; the observer is interested in the word as a whole, not in the details of the letters (this *Journal*, viii, 1897, 367 ff.).

Külpe had made experiments on the question before 1892 (Philosophische Studien, vii, 399), and gave a brief account of them in 1893 (see Outlines, 182 ff.). They were fully reported in 1902 (Philosophische Studien, xix, 508 ff.). The observer, placed under experimental conditions, was asked to say whether he saw or felt anything, and if so what it was like, and whether he thought that it was objective or subjective: the stimuli actually given were a faint illumination of the walls of a dark room, and a pressure upon a pressure spot, with variations of interval, duration, intensity, etc. Külpe concludes that the criteria of subjectivity and objectivity are neither immanent nor universal; so that the predicates objective (referable to an external stimulus) and subjective (attributable to the condition of the observer) are always secondary and empirical determinations. We may point out that our own experiments were, in a way, the converse of Külpe's; his instruction was to report any sight or touch, and to say whether it was a matter of perception or of imagination; we asked definitely for an imagination, and sought to substitute for this, or to incorporate in it, an otherwise supraliminal perception. By thus demanding an image, we gained a further advantage; for Külpe's method does not guarantee the arousal of 'centrally excited sensations.' Külpe himself declares, apropos of his visual experiments: "inwiefern auch central erregte Empfindungen dabei eine Rolle gespielt haben, wage ich jetzt nicht zu entscheiden . . . Dass an der Vermengung mit objectiven Erscheinungen auch central erregte Empfindungen mitgewirkt haben, ist wahrscheinlich" (P. S., xix, 528, 533). Our experiments evidently called up images in all those cases in which the perception was supplemented (lemon *on table*, etc.); while in the other cases, whether or not an image was called up, there was a presentation which simulated and was identified with an image—and this under the most careful scrutiny and with sustained attention. For the rest, it is worth while to note that the differences between perception and image of imagination found by Pillsbury are all of the kind described by Külpe as secondary or empirical.

Washburn, in her study of subjective colors and the after-image (Mind, N. S., viii, 1899, 32), remarks that "perception and idea differ ultimately only in the manner of their production. . . . Where the intensity of the peripheral process is reduced to a minimum, the resulting conscious state is seen to be practically identical in character with that produced by central excitation." And there are many other experimental indications of the introspective identity of sensation and image: the nature of the visual images in Galton's 'highest class;' the possibility of securing an after-image from a 'mental image' (Downey); the probability of the intervention of images in certain normal illusions (Seashore and others); the facts of the memory after-image, of synæsthesia, of hallucination. It is not our intention to review these topics, or to enter upon the question of the cerebral seat of sensation

and image: all this would carry us too far afield, and the time is not ripe for full discussion of the image of imagination upon an experimental basis. We wish only to remind the reader that our experiments have a positive, if fragmentary, experimental background.

Much has been made of Lotze's statement that "the idea of the brightest radiance does not shine, that of the intensest noise does not sound, that of the greatest torture produces no pain" (Outlines of Psychology, tr. 1886, 28; Medicinische Psychologie, 1852, 477 ff.; Microcosmus, I, 203 f.). Titchener has recently remarked that a view of this sort, in so far as it depends on an intensive comparison of sensation and elementary image (a thing impossible, for most persons, in the case of pain), is probably due to the intercurrent of the stimulus error (Experimental Psychology of the Thought-processes, 1909, 267); and experiments now (March, 1910) in progress in the Cornell laboratory serve definitely to confirm that hypothesis. Ziehen's dictum that "the ideas of the slightest rustling and of the loudest thunder exhibit no difference in intensity whatever" (Introd. to Physiol. Psychology, 1895, 154; Leitfaden, 1906, 136) is flatly untrue if the rustling and the thunder are reproduced in kind; if, that is, images of auditory imagination replace auditory perceptions; for auditory images, as will be shown in a later communication from the laboratory, possess the attribute of intensity. The very fact that statements such as these can be made witnesses to the extreme need of experimental observation.

In general, of course, the experimentalists incline to the view that there is no intrinsic difference between sensation and image. It is not our intention, again, to review this topic; the review would be premature. We refer only to A. Meinong's classical discussion in the Vierteljahrsschrift für wissenschaftliche Philosophie, 1888-9, Nos. 11, 12, 13; and to Münsterberg, Die Willenshandlung, 1888, 138 f.; Grundzüge der Psychologie, 1900, 311; Külpe, Outlines, 85, 183 (it is to Külpe, so far as we are aware, that psychology owes the terms 'peripherally excited' and 'centrally excited sensations'); Stumpf, Tonpsychologie, I, 1883, 260, 375 f.; Wundt, Human and Animal Psychology, tr. 1896, 14; Outlines of Psychology, tr. 1907, 31, 39; Physiological Psychology, I, tr. 1904, 13 f.; Pillsbury, Attention, 1908, 95; Titchener, Elementary Psychology of Feeling and Attention, 1908, 337; Text-book of Psychology, I, 1909, 198 f.

## § II. KINÆSTHETIC ELEMENTS IN IMAGES OF IMAGINATION AND IMAGES OF MEMORY

Our next concern was to bring the image of imagination into relation, for purposes of introspective comparison, with images of memory. As a stimulus to the image of imagination we could think of nothing more promising than the spoken word. There is, truly, no guarantee that the spoken word will arouse these images; but it seemed practically certain that, if a fairly large number of experiments were made, the two types of image would be found among the results. The observers were accordingly seated in a dark room, and instructed to give themselves up to the visual imagery evoked by the word; they were not in any way to control or regulate their imagery, but were to give it rein, passively and as association determined. No classification *a priori* was attempted.

It soon appeared that a good proportion of the images thus

aroused were of two sharply different kinds. There were, on the one hand, images of recognized and particular things, figuring in a particular spatial context, on a particular occasion, and with definite personal reference; and there were, on the other hand, images with no determination of context, occasion, or personal reference,—images of things recognized, to be sure, but not recognized as this or that particular and individual object. The former were evidently 'images of memory;' the latter, both by positive and by negative character, were 'images of imagination.' In other words, we have in our results a rough and ready criterion of the two types of image: memory being distinguished by particularity and personal reference, and imagination contrasting with it by lack of particularity (in the sense of a particular sample, placed and dated) and absence of personal reference. There were, naturally, a fairly large number of intermediate forms (images with personal and place references, but unfixed in time; images with personal reference, but neither temporal nor spatial context; images with context but no personal reference). The classification of these under the one or the other of the two main rubrics would have been possible, from the records, although it would have left a margin of uncertainty, aside from that due to the possibility of an incomplete introspective account. Fortunately, however, we had no need to attempt it, as the clear-cut cases were sufficiently numerous for our purpose.

One of the first things noticed, as we sought to analyze the images, was the presence of certain kinæsthetic factors in the image of memory which were not traceable in that of imagination. Sensations of eye-movement were by far the most obvious; memory appeared to imply roving movement of the eyes, while imagination implied steady fixation. The indications were that other and more general kinæsthetic differences obtained, but this, of eye-movement and fixation, was the most noticeable. In view of the important part played in theory by the kinæsthetic factor, we decided to put this discovery to the test of experiment.<sup>1</sup>

The observer sat in a dark room, his head supported in a

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<sup>1</sup> We naturally think of the seer and dreamer as rigid, in a fixed stare; and we know that the effort to remember sends our eyes wandering over walls and ceiling, as if we hoped somewhere to find a cue to memory. Cf. F. Meakin: Mutual Inhibition of Memory Images, *Harvard Psychological Studies*, i, 1903, 244; C. S. Moore: Control of the Memory Image, *ibid.*, 296; J. W. Slaughter: Behavior of Mental Images, this *Journal*, xiii, 1902, 548; F. Kuhlmann: Analysis of the Memory Consciousness, *Psychological Review*, xiii, 1906, 338 f.; E. Murray: Peripheral and Central Factors in Memory Images, this *Journal*, xvii, 1906, 241; Külpe: *Outlines*, 1909, 187; etc.

headrest, and his left eye screened. The right eye fixated a luminous (phosphorescent) spot 1.5 m. distant. Four other and similar luminous spots, at the same distance from the eye, were placed within and near the upper, lower, right and left margins of the blind spot of the fixating eye. A sixth luminous spot was placed to the right, just beyond the limit of the field of vision. So long as fixation was continued, or the fixating eye moved only within certain narrow boundaries, the outlying lights remained invisible; so soon as the movement of the eye attained a certain extent, some or all of the outlying lights flashed into the field.

The observer was required, first, to gain such control of fixation that the five outlying spots remained permanently invisible when the head was in position; there was some difficulty with all observers, but it was overcome by practice. In the experiments themselves, a signal was given, and then the word was called out to the observer, who signalled (by a minimal hand-movement, which did not at all disturb fixation) the appearance of an image. Careful and detailed introspections were taken of the course and character of the image, and a note was made of the appearance or non-appearance of outlying lights in the field while the image was in course. The time elapsing between the giving of the stimulus word and the arousal of an image was recorded by the experimenter; but no use will be made of this determination in the present paper. The observers were left altogether in ignorance of the object of the work; they soon discovered that the movements of the eye were in question, but no one of them, so far as we are aware, realized that we were in search of a distinction between image of memory and image of imagination. These terms were carefully avoided; the experimenter spoke only of 'image.'

Obvious sources of error were: the limit of function of the apparatus, the possibility that the observer should forget the appearance of outlying lights in his anxiety to do justice to the image, and the occurrence of intermediate and dubious forms of image. In so far as the apparatus allowed of slight movements, without sight of the lights, its limitation would serve to increase the number of observations of 'imagination with no movement,' and to reduce that of observations of 'memory with movement.' Yet the movement that would bring in the lights was very slight, and the movements involved in the memory image were gross; so that we do not ourselves attach weight to this source of error. The second we must accept; though the training and attention of the observers may be supposed to reduce it to a minimum. It appeared, without suggestion from the experimenter, in the introspections of the sentence-experiments (Experiment VI), and is there allowed

for. The third we avoided by discarding all equivocal results in our final calculations. Lest, however, this procedure should seem arbitrary and perhaps unfair, we sought in every instance to make a distribution of the doubtful cases, as impartially as possible, to the two main categories (an example is given in the auditory experiments: Experiment VIII); and in every instance the outcome of the combination told for and not against our main thesis.

*Experiment IV.* The observers, Messrs. Geissler, Tsanoff, and Williams, and Misses Clarke, Day, and Rand, were all graduate students; only *D* and *T* had had practice in the observation of images. After ruling out all equivocal images, 5 cases of images of printed words, and 16 cases in which mistakes of technique occurred, we had 426 experiments of which 212 gave images of memory (in the sense explained above) and 214 gave images of imagination. These results were somewhat irregularly distributed among the observers, but no observer reported less than 20 images of each kind.

Of the 212 memory images, 191 (or 90%) involved eye-movement, to the extent that outlying lights came into the field of vision; of the 214 images of imagination, 146 (or 68%) showed no evidence of movement. Of the 68 images of imagination for which movement was recorded, 12 were images of animals conceived as running swiftly across the field of vision, and 17 were images of greater extension than could be compassed by the resting eye,—images of a stretch of landscape, or of the side of a near and large building. If we rule these out as equivocal, we have only 21 anomalous cases of memory (no movement) and 39 anomalous cases of imagination (movement recorded).

*Experiment V.* In a second experiment, the experimenter selected the stimulus words with a view to the avoidance of very extended images, and of images of moving animals. Minor improvements in technique (size and permanence of the phosphorescent spots) were also effected. In spite of preliminary practice, some of the observers had reported a certain difficulty in the presence of the fixation spot; the peripheral stimulus seemed to interfere with the formation of the image. At the conclusion of the first experiment, however, this difficulty had been overcome; so that, on the whole, better results might now be expected. The observers were as before.

Of 227 memory images, 218 (or 96%) involved eye-movement; of 165 images of imagination, 122 (or 74%) showed no evidence of movement. But, in spite of precautions, 30 of the 43 refractory cases of imagination were cases in which the observer imaged an extended scene. Of the 122 cases without movement, 6 were also of extended scenes; but here no estimate could be made (as was ordinarily the case) of the distance of

the scene from the observer. In 10 of the remaining 13 cases of imagination with movement, the observer reported a fatigue of fixation before the appearance of the image. There were no other discoverable sources of error in the experiment.

*Experiment VI.* It did not seem probable that the weight of evidence could be increased by further experiments of this kind. There was, however, a possibility that the use of the single word as stimulus induced an artificial or abnormal steadiness of fixation, which would not exist if a series of images of imagination were passing through consciousness. We accordingly turned to serial stimuli; we employed sentences, bits of nursery rhyme, passages from Shelley's *Cloud*, Lanier's *Song of the Chattahoochee*, Kipling's *Chant-Pagan*. These were read slowly and distinctly by the experimenter; the observer signalled the appearance of an image, and the corresponding word was noted by the experimenter; introspections were taken at the end of the reading. The observers were R, T and W.

Of 94 memories, 68 (or 72%) involved eye-movement; of 269 imaginations, 243 (or 90%) showed no movement. In 10 cases (thrown out) the observers could not remember whether or not the lights had flashed into the field of vision. In the other cases, they felt fairly certain of their report; though the affective state aroused by the stimuli was at times so strong, and the interest in the images so intense, that peripheral stimuli might, perhaps, pass unnoticed. We must leave this possibility undetermined.

As might have been foretold from the imaginative character of the stimuli, there is a great preponderance of images of imagination. In many cases, an existing image or fusion of existing images served to form a context for a newly entering image, which still remained positively an image of imagination; the ready-made context did not make it over into an image of memory. Sometimes there was, in these cases, a sort of personal reference, but it was radically different from the reference of memory; the observer would 'see himself there' rather than feel himself there; he seemed detached from himself, filling "a blank space which represented himself;" "there was somebody in the boat which [*sic*] I supposed was myself." By this time, indeed, the observers had frequently remarked on a conscious difference in types of images, noting that "sometimes the context seems the important thing, and sometimes the image itself," and that a 'particular' image seemed to be of a different mental order from an unREFERRED image. It was time, then, to transcend the preliminary and non-psychological criteria that we had so far relied upon, and to seek to ascertain the introspective basis of this difference.

*Experiment VII.* Comparatively few observations were taken in this Experiment, as the introspective reports were made as full as possible. The observers were *D*, *T* and *W*. The word method was employed.

Of 39 memories, 35 (or 90%) involved eye-movement; of 61 imaginations, 53 (87%) showed no movement. Other determinations were as follows:

100% of imaginations reported that fixation was apparently necessary before images could be secured;

75% reported lively affective processes;

92% reported great vividness of imagery;

93% reported a 'feeling of personal detachment;'

41% reported a mood of strangeness or novelty.

Introspective comparison of the two types of image brought out the fact, for all observers, that "the difficulty in holding the fixation is greater with the particular than with the generic images ['generic' is a term employed spontaneously by the observer quoted]. The latter seem to require fixation anyway, it seems to build them up before your eyes as you gaze steadily, while for the others you seem to want to look around, or to be free in some sense, and the fixation-point seems to hamper you."

*Experiment VIII.* It was still a question, however, whether the kinæsthetic factor present in the process of memory were peculiar to visual imagery; and whether it were a responsive movement, or a preparatory movement of adjustment of the sense-organ involved. The latter question might also, in principle, be asked of fixation. We accordingly arranged an Experiment for testing the laryngeal movements that are associated with inner audition. The observer assumed a semi-recumbent position on a couch, the inclined portion of which supported the upper part of the body and the head. We hoped through this position to avoid head and body movements, as well as general muscular strains and fatigue. The Verdin laryngograph, rigidly supported, was applied to the larynx, and so adjusted that any movement which fell within its range of sensitivity could be recorded on a kymograph. Record was made, on the same surface, of the appearance of auditory images in the mind of the observer. The arm and hand signalling these appearances were comfortably relaxed, and preliminary tests were taken to make sure that the signal movements did not change the laryngographic tracing.

The observers were *D*, *W* and Mr. Nakashima; all graduate students. Three other persons who offered their services were rejected, since they were unable to obtain auditory images. Another had good images, but gave no record of laryngeal movement under any conditions; he had been a singer as a

boy, and had overstrained his throat,—a fact which may account for this absence of appreciable movement. The preliminary work with these rejected observers was useful as affording practice in the manipulation of the laryngograph. The word method was employed.

Of 155 memories, 84% (minimum 80%, maximum 90%)<sup>1</sup> involved movement; of 214 imaginations, 91% (minimum 90%; maximum 96%) showed no movement. There were 56 doubtful or equivocal cases. We have sought, on the basis of the very full introspections, to distribute these as fairly as possible to the two main categories; with the result that memories with movement rise to 86%, and imaginations without movement to 94%.

The averages here, however, are a little misleading. For *D* and *W*, the most practised observers, at no time recorded movement with images of imagination; and *D* gave but one case of memory without movement, while *W* reported only 6 such cases. *D*'s record was especially clear, the movement showing conspicuously in the tracing with the memories, and being as conspicuously absent with the imaginations.

This Experiment was repeated, with like result, after an interval; there were, again, three observers. We do not think it necessary to report the details.

*Experiment IX.* One of our observers, Miss de Vries, had mentioned that strong olfactory images were of common occurrence in her experience. Experiments were therefore made, again by the word method, in this department of imagery. The observer lay on the couch, in the position described above, with eyes closed, and signalled the appearance of an image. The experimenter carefully watched the observer's face for signs of movement. Introspections were taken after the image had run its course.

Of 56 memories, 96% involved movement of the nostrils, and 86% very definite movements, a sniffing in and out of the nostrils and a jerking of the head. Of 57 imaginations, 46 or 80% gave no perceptible movement. Of the remaining 11, 9 involved only a very slight twitching of the nostrils, just observable by the experimenter; and 5 of the corresponding images had a local visual setting, although this was not definitely recognized.

We lay no great weight upon these results, though they are evidently in accord with those obtained with vision and audition.

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<sup>1</sup>The record was delicate, and not always easy to read or interpret. Hence we give the possible minimum and maximum, as well as what seems to us and to our assistant readers the fairest percentage.

### No experiments were made upon the imagery of touch.

If we summarize the results of the foregoing Experiments, we have the following:

No. of Obs. Memory Imagination		Imagery	Percentage of Memory and Movement	Percentage of Imagination and No Movement
572	709	Visual	89.5	79.5
155	214	Auditory	84	91
56	57	Olfactory	96	80

As they stand, the figures are significant enough. But it must be remembered that we have, throughout, given the observation the benefit of the doubt; we have made no distinction between stages of practice, we have allowed full weight to discrepant observations which nevertheless could readily be accounted for (running animals, etc.). In other words, our figures are as low as they can be made, and might easily and without undue pressure of interpretation have been made higher.

### §III. AFFECTIVE FACTORS IN MEMORY AND IMAGINATION

It would be hasty to conclude, from the foregoing Experiments, that the imaginative consciousness is constituted as such by a typical distribution and proportion of kinæsthetic elements, and by this alone. Emphasis has been laid, in many quarters, upon the affective component in imagination, and it is necessary that the affective theory be brought to the test of experiment.

We thought, at first, of having recourse to the method of expression. But we gave up this idea: partly on account of the perplexity in which the method is itself involved, partly because we did not see how, at its best, it could help towards a solution of our problem. The questions at issue are whether there is a qualitatively characteristic mood which informs consciousness in memory and in imagination, and whether—granted that the moods exist—the imaginative consciousness is more strongly, more markedly affective than the memorial. We knew from Experiment VII that the word method could bring out reports of mood, and we accordingly adopted it, though in slightly modified form, in the present case.

*Experiment X.* We selected two observers who had vivid visual imagery: Miss de Vries, of whom we have already spoken, and Dr. Pyle, an assistant in the laboratory. Both observers were familiar with the standard investigations of mental imagery; and both had had practice in this field of observation. The new experiments were made in diffuse daylight: the observers sat at about 1.5 m. from a buff-colored blank wall; their eyes were open, but fixation was not prescribed. The general instruction was that they should report upon the mood accompanying or infusing their images; and that (if this procedure were of any help to them) they should

compare images of different types, in order that the moods should be intensified 'by contrast.' The instruction to compare the images set up, in both observers, a tendency to the alternation of imagination and memory, though this tendency was oftentimes cut across by the intrinsic suggestion of the stimulus. The results were similar for the two observers, and need not be separated.

Of 103 imaginations, 72% involve some mood of surprise. This was variously described as wonder, novelty, strangeness, queerness, unusualness, weirdness, fantasticalness, creepiness, peculiar discomfort, and lack of ordinariness. The imaginations not thus accompanied were almost always images of commonplace objects, which had been a part of the ordinary mental furniture of the observer; that is, they were habitual imaginations.

There were 154 memories. In many cases, the feelings and emotions connected with the remembered event were so strong that it was hardly possible to determine whether any affective coloring attached to the image as image. In all other cases, both observers found a recognitive mood; and both expressed the opinion, at the end of the series of observations, that a glimpse of this mood could be caught, by alert introspection, at some stage or other in the course of every memory image.

We may say then that, under the conditions of our experiments, surprise or novelty is the characteristic mood in imagining, and recognition or familiarity the characteristic mood in remembering. On the question of relative intensity, the observers thought that the mood of imagination appeared the stronger simply because it is not interfered with by other emotions or moods. The image of imagination is new and strange, and that—so far as our experiments go—is all; the image of memory is familiar, but it is also, as a rule, affectively colored in its own right. So the recognitive mood is likely to be swamped. When, however, the memory was indifferently, it seemed to be as strong as the mood of surprise in the corresponding imaginative consciousnesses. And had we succeeded in arousing images of imagination in which the observer took an inventor's pride, or which inspired him with disgust, then (our observers thought) novelty would have weakened to the ordinary level of familiarity.

We attempted no analysis of the moods of surprise and recognition; the conditions were evidently unfavorable to such work, and we desired only to find out what was present, in the imaginative and memorial consciousnesses, that could be considered as a characteristic affective formation. The mood of recognition is genetically, in all probability, a very degenerate form of the emotion of relief, of fear unfulfilled (Titchener, *Primer of Psychology*, 1900, 191). The mood of surprise, of novelty, of strangeness is apparently a weakened form

of our instinctive fear of the unknown; it shows its derivation, with what was to us an unexpected plainness, in its unpleasant nature: the observers speak of creepiness, weirdness, peculiar discomfort.

Instances of the suppression of novelty by another mood (pleasure in the completed image, charm) will be given later. It is probable that the generally unpleasant character of the mood of novelty, in the records of the present experiments, was due in part to the fact that the observers were dealing, not with a continuous imagination, but with single, detached images, and in part to the fact that these images were suggested to them by words coming in from the outside rather than by the course of their own consciousnesses: *cf.* Titchener, *op. cit.*, 207.

#### §IV. THE IMAGE OF MEMORY AND THE IMAGE OF IMAGINATION COMPARED

We have now to discuss in detail the introspective differences between the image of imagination and the image of memory. The initials *P* and *V*, in the following paragraphs, refer to the observers in Experiment X (daylight images). For other observations we rely mainly upon Experiment VII (dark room images).

##### I. FIXATION

*Imagination.* Both *P* and *V* noted, without instruction given, that fixation was necessary if an image was to appear at all. *V* could never move her image, though she could duplicate it at some other point on the wall after renewed fixation. She reported that she could see the original image in its original place, by indirect vision, while she held the new image in direct vision.<sup>1</sup> *P* thought that he could move his

Both *P* and *V*, again, found that the image nearly always image, but was in fact never able to follow it in passage, and said of his own accord that he was not sure it was not a new image, built up after renewed fixation.<sup>2</sup>

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<sup>1</sup>*Cf.* Moore: *op. cit.*, 302.

<sup>2</sup>All of our observers who could obtain images of visual imagination expressed their belief, when questioned, that they could move their images at will; we have noticed an instance under Exp. II. It seems, from the experience of *P* and *V*, that such movement is more probably a shift of fixation followed by the development of a new image; but the point demands further investigation. *Cf.* E. B. Huey, *Psychology and Pedagogy of Reading*, 1908, 32 ff.

*P* found that his images invariably tilted in position when he tilted his head; with great effort of attention he could sometimes right them. The same observer, who suffered from imbalance of the ocular muscles, was at times unable, towards the end of the experimental sitting, to hold a steady fixation; his images then 'rolled around' or 'turned somersaults.'

Both observers reported that they could follow the lines (*e. g.*, the curved lines of a coiled snake) within the image, as one can follow the lines in a stereographic perception.

remained unchanged as long as it was visible at all; like a perception, it stood still to be scrutinized, though it yielded no more detail than at the first glance. Occasionally, when the first appearance of the image was incomplete or otherwise unsatisfactory, transformations would be observed in the defective parts, or the entire image would flicker out, and a new one would take its place.<sup>1</sup>

Usually the image was on, or at the exact distance of, the wall. Sometimes, especially for *V*, it was nearer, and induced a "cross-eye feeling"; the point of fixation could then be roughly determined by passing the finger back and forth through the image and noting double-images. If the object imaged were too large for the field of vision at the distance of the wall, the perception of distance was rather uncomfortably disturbed; the image was 'felt' to be at the distance of the wall, but was of a size that the imaged object should have had at a greater distance. The wall, under these conditions, dropped out of consciousness, or remained only to color the atmosphere surrounding the image.

A series of 20 tests gave the average duration of *V*'s images as about 90 sec. The maximal duration noted was nearly 180 sec. If an effort was made to hold the image to the bitter end, it grew smaller and less distinct, receded in space, and finally faded out. Otherwise, it simply ceased to be there.

We may add the general statement that both *P* and *V* frequently reported absence of bodily movement, and lack of diffused kinæsthetic sensations, especially after comparing these images with the images of memory.

*Memory.* These images did not involve a steady fixation, but rather a definite eye-movement; the observer was conscious of seeking them in a definite direction.<sup>2</sup> The image appeared with a determinate orientation to the observer, which might, however, differ widely from that of the original experience. When once the image had appeared, the observer could very rarely, and then only with the greatest effort of attention, get it with any other orientation; if he succeeded, the image

<sup>1</sup> Several experimenters have reported oscillation or fluctuation of the image. *V* sometimes noticed fluctuations, at first of a period of some 40 sec., and then of increasing frequency. Fluctuation seems to vary not only with the individual, but also with the condition of the individual. Cf. Moore: *op. cit.*, 295.

Both observers found that the image flickered with winking, and that if the eyes were closed it usually disappeared or, at best, remained for a very short time.

<sup>2</sup> This point has been noticed by many investigators: Fechner, Kuhlmann, Meakin, Moore, Murray, Slaughter.

was a 'ghost image,' barely perceptible and very difficult to hold. Neither *P* nor *V* was able to move the image.<sup>1</sup>

The image was fleeting and instable; it could not be deliberately scrutinized; it stayed for 10 seconds at most. The strong tendency was to move incessantly from part to part of the image-content.<sup>2</sup>

As a rule, the images appeared to be some distance away, often approximating the distance of the remembered object from the observer at the time of observation.

The images involved a good deal of general kinæsthesia. *V* could see the pail, which on the remembered occasion she swung in her hand, only by holding her arm up before her eyes as she sought to form the image. So far as introspection could determine, the movements involved in memory were weaker duplicates of those involved in the remembered experience.<sup>3</sup>

## 2. VISUAL CHARACTERS

*Imagination.* The images were apt to take on the illumination of their surroundings. In the dark room, they were dusky, apparently illuminated by the phosphorescent fixation spot. Sometimes this spot became an integral part of the image: a candle in a window, a lantern in a cave, etc. In the daylight they were much lighter; closing the eyes darkened them, and tinged them with red. They often took on a fringe or halo of the color of the wall.

*V* incidentally noted a distinct after-image succeeding the image of a fire. After this observation, *P* and *V* made special tests of the arousal of after-images. *P* was never certain that he obtained an after-image, though at times he thought he had a vague negative image. *V* obtained several fairly distinct negative after-images.

On certain occasions, when the image was very near, *V* tried the effect of alternate monocular observations, and found that the image changed precisely as perception changes.

*Memory.* The images did not take on the illumination of their surroundings; even in the dark room they retained their daylight character, if the originals had been daylight experiences.<sup>4</sup> The fixation spot in the dark room never became

<sup>1</sup> *P* found that it did not alter its position when he tilted his head. The image did not, for either observer, flicker with winking, nor did closing the eyes banish it.

<sup>2</sup> Cf. Murray: *op. cit.*, 231; Slaughter: *op. cit.*, 531.

<sup>3</sup> Cf. G. M. Whipple: this *Journal*, xiii, 1902, 259 f.

<sup>4</sup> We had no objective control of the dullness or brightness of these images; for that, recourse must be had to simpler modes of image (Bentley, this *Journal*, xi, 1899, 42 f.). The point here is that the imaginations were dark in the dark and light in the light, while the

a part of the image. In the moderate diffused daylight of the laboratory, the observers felt themselves blinking in the glare of a remembered sunny path. Illumination was not affected by closing the eyes. There was no fringe from the color of the wall. No after-image was obtained from a memory image.

The visual imagery was scrappy and fleeting. The observer would be aware that there were large blanks in the visual picture, but the instant he turned his attention to any particular blank it was no longer empty, but filled by a bit of imagery. Trial was made in vain to trace the boundaries of the blanks, or of their visual fillings. There was a great deal in consciousness (organic, kinæsthetic processes) which the observer could convert at any moment into visual contents. The visual contents themselves were filmy; 'colorless etchings,' 'rough outlines;' they fused so intimately with the entire mental complex that the observer was forced, again and again, to remark "I don't know what I see and what I don't see." The images of imagination were oftentimes, on the contrary, very highly colored.

### 3. AFFECTIVE AND ORGANIC ELEMENTS

*Mood.* The mood of imagination is, as we have seen, that of surprise (unfamiliarity, novelty, strangeness); the mood of memory is, patently, the recognitive mood. In the case of habitual imaginations, of what one of our observers termed 'generic images,' there was either no affective setting or a very weak mood of familiarity.

We were especially interested to discover feelings of reality (or unreality) and activity (or passivity). Both types of consciousness usually excluded any thought of the image as an image; the image engrossed the attention, and the experience was real. However, we gained some hints—more could not be expected—of the basis and contents of the feelings mentioned.

In the case of imagination, the observers sometimes remarked that they "felt as if it had been a dream," that they had "lost time." Here was a feeling of unreality. More often they would say: "it seemed more real than reality;" "not so real as the memory, of course, if you consider it as an experience, but more really there, real as shadows are real;" "the imaginary rabbit was more real than the memory rabbit, more rabbit, and more there." Here was a feeling of something like perceptual reality. Again, "it had objective reality; not as if I had anything at all to do with it." Here was a feeling of independent reality, of the detachment of the image from the observer.

The feeling of perceptual reality seemed to be due, directly, to the sensible characters of the image; its intensity, definite color, duration, stability, steady position in a definite plane, suddenness of entrance when looked for, its wholeness and self-containedness as compared with the image of memory. The observer "took it as if it was an ob-

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memories were dark or light, independently of surroundings, according as they pictured darkness or lightness in the original experience.

ject to be looked at," he "stood off and watched it." The feeling of perceptual reality appeared to be the conscious concomitant of the attitude of contemplative vision; steady fixation, with general muscular relaxation. The feelings of unreality and of independent or detached reality were based—the former, it seemed, exclusively, the latter principally—upon the lack of kinæsthesia. The observers often remarked that they "had done nothing about the image," that they had not responded to it as they would have done to a perception. This was one reason for the difficulty of distance localization; not only was the observer aware that he got, *e. g.*, an entire person into the field of vision, as he could not have got a real person at the given distance, but he was also disturbed by the absence of any kinæsthetic cue or bodily reaction of his own, by which he might gauge the distance. The dream-character may, then, be ascribed to the lack of kinæsthesia. The feeling of detached reality is due in part to this lack, and in part to the perceptual character of the image itself.

The feeling of reality that attached to the memory image was of a different kind; it was the feeling of real occurrence in past personal experience. The observers identified it with the recognitive mood, together with the conscious concomitants of movements; movements of adjustment, of response, of imitation. These movements fairly abounded; the observer was not now a spectator of a show, but a responsible participant in the experience.<sup>1</sup>

The conditions were not fitted for anything like an exact analysis. We add only that all observers were clear that the feelings of reality and unreality were complex, and that they would analyze into organic and kinæsthetic factors.

The image of imagination was not often accompanied by a feeling of activity; usually it "just came of its own accord." Sometimes, however, there was a feeling of exhilaration, of enhanced mental activity. On a few occasions (not invariably) we were able to connect this feeling of mental activity with the travelling of the point of regard over the lines of the image, and its 'active' examination in detail. The memory image, also as a rule, came of itself, and was receptively, passively taken; though at times there was a feeling of restless activity, always (so far as we noted) accompanying movements of imitative exploration. But the feeling of activity was not, in these experiments, at all a marked feature either of the imaginative or of the memorial consciousness.

*Organic Factors.* In the case of imagination we find, besides the organic concomitants of concentrated attention, a good deal of empathic sensation. With an image of a bunch of grapes the observer spoke of "a cool, juicy feeling all over;" with a parrot, of "a feeling of smoothness and softness all over me; not tactual [*i. e.*, not cutaneous];" with a fish, of "cool, pleasant sensations all up my arms; slippery feeling in my throat; coolness in my eyes. The object spreads all over me and I over it; it is not referred to me but I belong to it;" with a bowl, of "organic sensations in chest; cool object in

<sup>1</sup> On one occasion the observer *V* had side by side a pure fancy image and an indefinitely recognized but still distinctly memorial image of memory. She was able to look several times from the one to the other, and to compare both the images themselves and her attitude to them. She reported that "the two moods were strikingly different; it would be impossible ever to bring the two images together; both were real, but it was as if the reality belonged to two different thinking organs."

and against it;" with an apple, of "cool juicy round feeling in myself;" with a rose, of "nothing except sensations of pink; I seem to swim around in it and it went all over me." Introspections of this type were very frequent, though not always as explicit as those quoted. Frequently the observer called out, after the image had run on for a few seconds, "there! I seemed to jump into it; went all over me." Sometimes, however, the organic sensations were present from the first.

While the image of memory brought with it into consciousness many organic factors, these were always of an imitative sort, factors that had been concerned in the original experience. The kinæsthetic and organic elements were, in very many cases, at least as important as the visual imagery itself; we have quoted an observer to the effect that he was doubtful as to what he saw and what came from other cues. The whole organic effect was radically different in the two types of consciousness.

#### 4. TEMPORAL COURSE

The images of imagination appear more quickly, more suddenly, and more as a whole, than the images of memory. They persist longer, and are far less changeable during their course.

These statements, in their relative form, hold for all observers, in spite of considerable individual variation.

#### 5. STATE AND ARRANGEMENT OF CONSCIOUSNESS

In imagination, the attention is very narrowly focussed; there is a close resemblance to the hypnotic consciousness. The absence of the large motor responses eliminates much of the ordinary perceptual consciousness. We have as a result great clearness and intensity of the image, its spatial isolation in a surrounding haze, and the affective and organic concomitants noted above.

The word 'charm' was sometimes used to express the feeling of pleasurable excitement which went with this semi-hypnotic state. "It had the charm of a dream; felt like a dream." "It does not feel normal, though it feels real." "It is prettier than a rose ever was," "redder than wine ever was," "greener than any grass," "more brilliant than emeralds," "I feel myself through it as through a fog; the lights and shades help, and give it charm." "It is clear, though in a dim light;" "clear as an image but not as an existence;" "the only thing in consciousness;" "I became the image;" "one part stands out very clear; beyond it shades off into a fog or haze;"<sup>1</sup> "it looks as things look when you turn your head upside down." All these reports point to a high level of attentional clearness.

In memory, on the other hand, attention is wandering and

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<sup>1</sup>Cf. W. Lay: *Mental Imagery*, 1898, 3.

diffused. It hurries to a number of diverse factors, and rests on none. Tactual, auditory and visual images combine with organic sensations into an instable flux, sent into many channels by as many different cues. The visual image flits through consciousness, now this and now that feature of it rising to clarity and claiming interest, but all passing so swiftly that introspection is difficult. In general, the visual image is flat and thin, without much perspective or light and shade, and without the peculiar vividness of coloring that we find in the image of imagination. It is so entangled with the self-feelings and with kinæsthetic bits of spatial direction and arrangement, that the observer is at a loss to know what he sees, while he knows that he is conscious of much more than he sees; he is conscious of an underlying fixity of occurrence, of a total setting in which the visual images sink and are lost, of a breadth of context in which he can move at will, converting into visual terms this or that detail, as his interest prompts. All this is given in attitudinal terms, with definite fragments of imagery, or kinæsthesia, or some organic complex, rising in quick succession to the level of clearness.

The patterns of the two consciousnesses are thus essentially different. In imagination there is a permanent narrowing of consciousness, with inhibition of all irrelevant associative material; in memory, consciousness is as it is in the ordinary waking state as contrasted with hypnosis, a formation that now narrows and now broadens, liable to the irruption of any chance association. The great difference between memory and perception derives from the elimination of sensations of special sense, and the consequent predominance of kinæsthetic and organic factors.

#### SUMMARY

We have used the phrases 'image of memory' and 'image of imagination' to denote, not the elementary image-process that is co-ordinate with sensation, but a complex formation, of the same level as the perception.

(1) We find that, under suitable experimental conditions, a distinctly supraliminal visual perception may be mistaken for and incorporated into an image of imagination, without the least suspicion on the observer's part that any external stimulus is present to the eye. The perception may be of such definiteness that instructed and competent observers, in presence of it, have declared our results 'incredible' and have pronounced the stimulus 'ridiculously real.' Yet there was not one uninstructed observer who discovered the deception for himself. It follows that the image of imagination must have much in common with the perception of everyday life.

(2) For preliminary purposes, images of memory may be distinguished from images of imagination as having particularity and personal reference.

(3) We find that, in the great majority of cases, memory images of sight, sound and smell involve gross movements of eyes, larynx and nostrils, while the corresponding imaginations involve no such movements.

(4) A detailed comparison of visual images of memory and of imagination brings out the following differences: memory involves eye-movement and general kinæsthesia, imagination involves steady fixation and lack of general kinæsthesia; memory images are scrappy, filmy, and give no after-images, while images of imagination are substantial, complete, and sometimes give after-images; the mood of memory is that of familiarity or recognition, intrinsically pleasant, the mood of imagination is that of unfamiliarity or novelty, intrinsically unpleasant; memory implies imitative movement and the correlated organic sensations, imagination implies kinæsthetic and organic empathy; memory images arise more slowly, are more changeable in course, and last less long than images of imagination; memory implies roving attention and a mass of associative material, while imagination involves concentrated and quasi-hypnotic attention with inhibition of associations.

We thus reach the general conclusion that the materials of imagination are closely akin to those of perception. Popular psychology looks upon memory as a photographic record of past experience, and regards imagination as working with kaleidoscopic, instable, undependable materials. Precisely the reverse appears to be true. The image of memory is stable and fixed in meaning, in reference; but it is exceedingly instable as conscious content. The image of imagination is the photographic record, a stable formation that stands still to be looked at. This state of affairs seems, indeed, after the event, natural enough. It is just because the memory image is instable, liable to all sorts of interchange, suppression, short-cutting, substitution, telescoping, that it is psychologically available for memory; that a mass of past experience can be packed into small representative compass. And it is just because the image of imagination is stable and unchanging that it is psychologically available for the artistic purpose, for constructive embodiment. If an image could not decay, we should have but little memory; if an image could not persist, we should have but poor imagination.

It is now a question whether the stability and vividness of the image of imagination are due simply to its kinæsthetic support, to the immobility of the organ of sense, or whether peripheral sensory excitations are actually involved in it.

We incline to the latter view, though we regard the kinæsthetic support as a contributing factor.

Finally, we wish to emphasize the point that our results, positive as they are, hold at present only for the conditions under which they were obtained and for the observers upon whose introspections they rest. Any attempt at generalization would be premature. We have found that imagination is distinguished from memory by sensory vividness; but it may be that this vividness is not essential to imagination, and in any case it does not mark off imagination from pictorial thought. We have not found that imagination is in general more markedly emotive than memory; but, under other circumstances, this may prove to be the case. We have not found that imagination implies a plan, a voluntary synthesis; yet it may do so in other cases. We have dealt only with two complexes, of a low degree of complication, which had the advantage that they were easily manageable, that they were promptly distinguished by our observers, though at first in non-psychological terms, and that their distinction is definitely of the kind that, in the text-books, separates memory from imagination. Even if our results are verified by other investigators, the great bulk of the chapter on the Experimental Psychology of Imagination remains to be written.